

PROCESS FOR MAKING A COMPOSITION FOR CONVERSION TO
LYOCELL FIBER FROM AN ALKALINE PULP HAVING LOW AVERAGE
DEGREE OF POLYMERIZATION VALUES

5

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a divisional application of U.S. Application No. 09/574,538, filed May 18, 2000, now pending, which in turn is a continuation-in-part of U.S. Application No. 09/256,197, filed February 24, 1999, now U.S. Patent No. 6,210,801, which in turn is a continuation-in-part of U.S. Application No. 09/185,423, filed
10 November 3, 1998, now pending, which in turn is a continuation-in-part of U.S. Application No. 09/039,737, filed March 16, 1998, now U.S. Patent No. 6,235,392, which in turn is a continuation-in-part of U.S. Application No. 08/916,652, filed August 22, 1997, now abandoned, and claims the benefit from U.S. Provisional Application Nos. 60/023,909 and 60/024,462, both filed August 23, 1996.

15

FIELD OF THE INVENTION

The present invention is directed to processes and methods for making pulps useful for making lyocell fibers. In particular, the present invention is directed to processes for making compositions for conversion to lyocell fibers by contacting a pulp with an oxidant to reduce the average degree of polymerization, without substantially
20 reducing the hemicellulose content or substantially increasing the copper number.

BACKGROUND OF THE INVENTION

Cellulose is a polymer of D—glucose and is a structural component of plant cell walls. Cellulose is especially abundant in tree trunks from which it is extracted, converted into pulp, and thereafter utilized to manufacture a variety of products. Rayon is the name given to a fibrous form of regenerated cellulose that is extensively used in the textile industry to manufacture articles of clothing. For over a century strong fibers of rayon have been produced by the viscose and cuprammonium processes. The latter process was first patented in 1890 and the viscose process two years later. In the viscose process cellulose is first steeped in a mercerizing strength caustic soda solution to form an alkali cellulose. This is reacted with carbon disulfide to form cellulose xanthate which is then dissolved in dilute caustic soda solution. After filtration and deaeration the xanthate solution is extruded from submerged spinnerets into a regenerating bath of sulfuric acid, sodium sulfate, zinc sulfate, and glucose to form continuous filaments. The resulting so-called viscose rayon is presently used in textiles and was formerly widely used for reinforcing rubber articles such as tires and drive belts.

Cellulose is also soluble in a solution of ammonia copper oxide. This property forms the basis for production of cuprammonium rayon. The cellulose solution is forced through submerged spinnerets into a solution of 5% caustic soda or dilute sulfuric acid to form the fibers, which are then decoppered and washed. Cuprammonium rayon is available in fibers of very low deniers and is used almost exclusively in textiles.

The foregoing processes for preparing rayon both require that the cellulose be chemically derivatized or complexed in order to render it soluble and therefore capable of being spun into fibers. In the viscose process, the cellulose is derivatized, while in the cuprammonium rayon process, the cellulose is complexed. In either process, the derivatized or complexed cellulose must be regenerated and the reagents that were used to solubilize it must be removed. The derivatization and regeneration steps in the production of rayon significantly add to the cost of this form of cellulose fiber. Consequently, in recent years attempts have been made to identify solvents that are capable of dissolving underivatized cellulose to form a dope of underivatized cellulose from which fibers can be spun.

One class of organic solvents useful for dissolving cellulose are the amine—N oxides, in particular the tertiary amine—N oxides. For example, Graenacher, in U.S. Patent No. 2,179,181, discloses a group of amine oxide materials suitable as solvents. Johnson, in U.S. Patent No. 3,447,939, describes the use of anhydrous N—methyilmorpholine-N-oxide (NMMO) and other amine N—oxides as solvents for cellulose and many other natural and synthetic polymers. Franks et al., in U.S. Patent Nos. 4,145,532 and 4,196,282, deal with the difficulties of dissolving cellulose in amine oxide solvents and of achieving higher concentrations of cellulose.

Lyocell is an accepted generic term for a fiber composed of cellulose precipitated from an organic solution in which no substitution of hydroxyl groups takes place and no chemical intermediates are formed. Several manufacturers presently produce lyocell fibers, principally for use in the textile industry. For example, Accords, Ltd. presently manufactures and sells a lyocell fiber called Tencel® fiber.

It is believed that currently available lyocell fibers are produced from high quality wood pulps that have been extensively processed to remove non-cellulose components, especially hemicellulose. These highly processed pulps are referred to as dissolving grade or high alpha (or high α) pulps, where the term alpha (or α) refers to the percentage of cellulose. Thus, a high alpha pulp contains a high percentage of cellulose, and a correspondingly low percentage of other components, especially hemicellulose. The processing required to generate a high alpha pulp significantly adds to the cost of lyocell fibers and products manufactured therefrom.

For example, when the Kraft process is used to produce a dissolving grade pulp, a mixture of sodium sulfide and sodium hydroxide is used to pulp the wood. Since conventional Kraft processes stabilize residual hemicelluloses against further alkaline attack, it is not possible to obtain acceptable quality dissolving pulps, *i.e.*, high alpha pulps, through subsequent treatment of Kraft pulp in the bleaching stages. In order to prepare dissolving type pulps by the Kraft process, it is necessary to give the raw material an acidic pretreatment before the alkaline pulping stage. A significant amount of material primarily hemicellulose, on the order of 10% or greater of the original wood substance, is solubilized in this acid phase pretreatment and thus process yields drop. Under the prehydrolysis conditions, the cellulose is largely resistant to attack, but the residual hemicelluloses are degraded to a much shorter chain length and can therefore